

## 2.2 Airports Technology Program Area Description

### Mission

The U.S. airport system consists of 6 billion square feet of pavement with a replacement value estimated at \$100 billion. There are over 600 million passenger enplanements each year at over 17,000 landing facilities with terminal buildings and access roads. Current trends indicate that the aircraft fleet will not only increase in number, but also more importantly, in operating speed, gear loading and configuration, and aircraft size; traffic demands by the year 2010 will have doubled; and airport pavements will need capital improvements costing billions of dollars.

The Airport Technology program's mission is to provide technology solutions that will allow the Nation's airports to accommodate the projected traffic growth and establish an operational environment that is free of accidents and fatalities. This is accomplished by fulfilling the FAA's regulatory obligation (49 U.S.C. 47105(b) 3) to develop standards, criteria, and guidelines for planning, designing, constructing, operating, and maintaining the massive airport system. This includes:

- Airport pavement design
- Airfield design
- Wildlife hazard mitigation
- Visual guidance systems
- Surface traction
- Post-crash rescue and firefighting
- Wildlife control

### Intended Outcomes

The most important program outcomes are reducing or eliminating aircraft accidents and lowering the cost of developing and maintaining safe airports.

The Airport Technology program area supports several FAA Strategic Plan goals:

- **System Safety:** reduce the number of accidents and incidents occurring on or near the airport surface. Current areas of emphasis involve the reduction of incidents in which airport surface condition is a cause or factor, reduction of hazards from wildlife strikes, and

reduction of runway incursions and runway transgressions.

- **System Capacity:** enhance airport capacity.
- **Industry Vitality:** enhance the vitality and international competitiveness of the U.S. commercial air transportation industry.
- **Global Leadership:** in cooperation with industry and other Federal agencies, promote U.S. aviation system technologies.
- **Environmental Responsibility:** create an environmentally effective and responsive FAA both domestically and internationally.

**System safety** — Reduction or elimination of aircraft accidents and incidents is supported by a comprehensive R&D program. The program seeks to reduce the risk of aircraft sliding off runways due to the presence of water, snow, ice, and man-made surface contaminants such as rubber and anti-icing materials. Improved runway traction is the central focus of this research, which will provide improved methods, materials, and procedures for detecting and removing contaminants from runway surfaces.

The effectiveness of soft-material arrester beds has already been proven in stopping an overrunning aircraft, and the program is developing national standards for design. More economical materials and installation methods must be found, though, to encourage more of these installations. Ongoing research in the area of wildlife control at or near airports seeks methods of reducing hazards from wildlife strikes with the aircraft. This includes cooperative research with the Department of Agriculture in assessing wildlife hazards at airports and maintaining a national birdstrike database.

Continued research in visual guidance systems is necessary to improve the safety of ground operations during daytime, nighttime, and under low-visibility conditions. Pilots and vehicle operators must receive clear and unambiguous information from lights, signs, and markings. Improvements in this area will help eliminate runway incursions and aircraft collisions on airport surfaces. State-of-the-art light sources and applications are nec-

essary to enhance the safety and efficiency of aircraft operations.

**Industry Vitality, Global Leadership, and System Capacity** — These are supported by a comprehensive research and development (R&D) program for airport pavement design with U.S. and international government and industry support and collaboration. The International Civil Aviation Organization (ICAO) has formally agreed to use the results from the Airport Technology program to develop worldwide pavement design standards.

The FAA's pavement research has the potential to provide large benefits. Approximately \$2 billion is spent on constructing, rehabilitating, and maintaining airport pavements each year by Federal, State, and local governments and by airport operators; about \$4 million is spent on research. Increasing the pavement life by as little as 10 percent through research would result in a 50 to 1 benefit/cost ratio. This is an attainable goal the program is working to achieve.

ICAO relies heavily on the results of visual aids research performed in the United States. To an increasing extent, visual aids research is being performed in cooperation with the United Kingdom and other European countries in order to reduce costs and to develop uniform international standards.

Research efforts are required to develop strategies for attacking post-crash fires on new multilevel, high-density seating, passenger aircraft being designed by manufacturers around the world. Elevated waterway and boom penetration devices are examples of ways to provide increased passenger survivability and evacuation protection. Training requirements and firefighting simulators must still be developed to fully utilize the new capabilities. ICAO is using research results to develop international firefighting standards.

### Program Area Outputs

The airport advisory circular system is the principal means by which the FAA communicates with the user community—the Nation's airport planners, designers, operators, and equipment manufacturers. Advisory circulars (AC) present the standards used in the design, construction, installation, maintenance, and operation of airports and airport equipment. In all projects funded through

the Airport Improvement Program (AIP), project work must meet standards set in one of these ACs. This requirement ensures, for example, that the \$100 billion investment in airport pavement is protected, by requiring pavement construction to meet standards for design, performance, and durability. In addition, these circulars provide information that promotes safe and efficient operation under adverse weather conditions.

Over 100 ACs have been published on a wide range of technical subjects, including airport design configuration standards, pavement design and material, lighting and navigational aids, firefighting equipment and procedures, pavement condition weather sensors, wildlife control, terminal building design, snow/ice control, and friction-measuring equipment and procedures.

The FAA updates ACs as and when necessary. The information and data collected in our entire Airport Technology R&D program culminates in the updated ACs.

### Program Area structure

Various elements of the Airport Technology program area affect the safety and operation of aircraft at or near the airport. Factors that determine the eventual safety of a flight include:

- Push-back from gate
- Movement on aprons, holding bays, de-icing pads, etc.
- Taxi to/from runway
- Visibility conditions
- Pavement configuration
- Lighting, markings, and signs to guide the aircraft to/from the runway
- Other ground traffic
- Runway surface conditions
- Presence of birds or deer
- Available overrun area beyond the ends of the runway
- Pavement structural integrity

In addition, the potential of rejected takeoff and possible rescue efforts is a safety concern associated with every flight. This program area systematically addresses these issues with a single deter-

mination to establish an operational environment that is free of accidents and fatalities.

### **Customer/Stakeholder Involvement**

Airport Technology's major projects support the overall FAA mission of fostering a safe and efficient airport system. Runway traction research directly supports the FAA Challenge 2000 recommendation to develop new technologies and standards for runway friction measurement and safety overrun arrester systems.

Several issues in the Aviation Safety Plan are supported by Airport Technology research. These include preventing runway incursions; improving takeoff and landing performance monitoring; developing environmentally acceptable alternatives for deicing and anti-icing agents; and improving ground navigation technologies, planning, standards, signage, and procedures.

Airport Technology rescue and firefighting research supports an ICAO initiative to replace environmentally harmful Halon 1211 for extinguishing engine fires and other fuel fires.

Aircraft manufacturers and the FAA urgently need new pavement design standards for operating next generation heavy aircraft. Manufacturers need them to assure compatibility of their aircraft on airport surfaces throughout the world. The FAA needs them to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent to protect the \$100 billion infrastructure investment.

These standards will be developed from data being collected on the National Airport Pavement Test Machine—the first-ever of its kind—over the next 10 years. Both the FAA and the Boeing Company are stakeholders in this important project. Financed through a cooperative R&D agreement between the FAA and the Boeing Company, the design and construction of the Machine has been completed and operation of the facility began in June 1999. Boeing is providing \$7 million (one-third of the total cost) towards its completion. The FAA, Boeing, and ICAO will develop pavement design standards for ensuring aircraft-airport compatibility on a worldwide basis.

### **Accomplishments**

During the past five years, the Airport Technology Program has provided products that have enhanced the safety of aircraft operations in the United States and around the world. Research underway, and which will continue into the future, will save the public billions of dollars and protect the environment while attempting to provide an operational environment free of accidents and fatalities.

The Airport Technology Program has provided an engineering solution to aircraft overruns by developing the engineered materials arresting system. The Port Authorities of New York and New Jersey have authorized installation of up to five systems at New York airports at a cost of \$4.5 million. The first installation was completed in December 1996 at JFK. The recent overrun of Eagle Saab 340 (May 8, 1999) at JFK and its eventual arrestment and rescue of all 27 passengers and crew of 3 is a prime example of payoff of our research in the engineered materials arresting systems.

The Airport Technology Program has developed a concept for an advanced taxiway system to automatically guide aircraft to and from runways and ramps during low-visibility conditions by controlling taxiway lights and signs without inputs from radar devices. A field demonstration is planned in FY 1999. This system will reduce inadvertent aircraft incursions.

The program has improved pavement marking performance by adding retro-reflective glass beads and silica, which enhances their visibility, durability, and skid resistance.

The program has successfully tested an innovative technology for aircraft deicing using infrared energy. The first installation was completed at Rheinlander airport in Wisconsin. This technology offers potential cost savings over conventional methods.

The program has introduced a new pavement design standard to accommodate the new Boeing 777. The new standard allows the aircraft to operate without weight penalties on existing pavements. Without this standard, hundreds of millions of dollars would have been needed to strengthen U.S. airport pavements.

The program has developed a Driver's Enhanced Vision System to allow airport rescue and fire-fighting vehicles to navigate through fog, rain, sleet, and snow. This technology enables quick and effective response to crash sites. Several airports around the country have adopted this technology for their rescue vehicles.

### **R&D Partnerships**

The Airport Technology Program is committed to working closely with airport operators and experts from all branches of the aviation industry and with existing experts and facilities in the Department of Defense, academia, highway sectors, foreign countries, and the ICAO. The program developed several cost-effective partnerships and agreements, including:

- FAA-U.S. Army Waterways Experiment Station, Interagency Agreement (Pavement)
- FAA-U.S. Army Philadelphia District Office, Interagency Agreement (Pavement)
- FAA-U.S. Air Force, Tyndall Air Force Base, Interagency Agreement (Aircraft Rescue and Fire Fighting)
- FAA-University of Illinois/Northwestern University, Center-of-Excellence for Airport Pavement Research, Partnership through matching funds
- FAA-Boeing Company, Cooperative Research and Development Agreement, Partnership through \$7 million influx from Boeing towards the Test Machine
- FAA-Canada (Public Works and Government Services) Project Arrangement for cooperative research in pavement technology

- FAA-NASA Memorandum of Understanding for joint runway traction research

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

### **Long-Range View**

Support for friction testing of new products to eliminate slipperiness as a cause of accidents will continue beyond 2005. Operation of FAA's national pavement test facility began in June 1999 and will continue for ten years. The data collected from the test machine will allow smooth introduction of new heavy aircraft expected to join the fleet well into the next century. The pavement design standards based on these data will:

- Provide assurance to manufacturers about the compatibility of their aircraft with airports throughout the world.
- Provide airport operators precise costs estimates to permit new aircraft operations at their facilities.
- Allow airlines to plan for new equipment and routes.
- Give airport designers confidence in their designs.

This long-range commitment to improving airport technology gives the FAA the tools required to assure the public that Federal funds are being judiciously spent and that public investment in infrastructure is prudently managed.

## A05a — Airport Technology

### GOALS:

**Intended Outcomes:** The FAA intends to improve airport system safety, efficiency, and capacity through advancements in aircraft technology and air traffic control systems. The FAA will also develop and maintain standards in all airport system areas to:

- Reduce aircraft accidents due to incursions, particularly in low-visibility conditions.
- Reduce aircraft accidents due to slipperiness caused by ice and snow on runways.
- Reduce environmental impacts due to chemical usage on airports during winter operations.
- Reduce the massive investment required for pavements.
- Improve post-crash rescue and firefighting capabilities.
- Reduce the negative impact of wildlife on airport safety.

**Agency Outputs:** The FAA is required by law to develop standards and guidance material for airport design, construction, and maintenance. The FAA uses the airport advisory circular (AC) system as its principal means of communicating with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers. ACs cover airport geometric design, pavement design, safety areas, visual aids, access roads, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices enforce standards and guiding material when administering the Airport Improvement Program (AIP).

The Airport Technology program provides the technical information necessary to support and update these agency outputs in a timely manner.

**Customer/Stakeholder Involvement:** Approximately \$2 billion is spent annually to provide operationally safe and reliable airport pavements. The FAA provides about half of this amount as AIP grants; State and local governments and airport operators provide the remainder. Projects funded under the AIP grants must conform to the FAA ACs or standards.

Aircraft manufacturers need new pavement design standards for operation of next-generation heavy aircraft to ensure compatibility of their aircraft with airport surfaces throughout the world. To accomplish this, the FAA and the Boeing Company have entered into a Cooperative Research and Development Agreement (CRDA) to build a unique full-scale pavement test facility at the agency's William J. Hughes Technical Center. The FAA, the Boeing Company, and the International Civil Aviation Organization (ICAO) will use data collected from the project in developing international pavement design standards.

The FAA needs these standards to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent and also to protect the \$100 billion investment in the U.S. infrastructure.

**Accomplishments:** During the past five years, the Airport Technology research program has provided products to enhance the safety of aircraft operations in the United States and around the world. Research results are published as FAA ACs and made available to users worldwide. Some major accomplishments are:

- Installed soft-ground arresting systems for stopping aircraft overruns at a major international airport (On May 8, 1999, the arrestor bed installed at John F. Kennedy International Airport, New York, safely stopped a Saab 340 aircraft carrying 27 passengers and 3 crew members, from possibly plunging off the end of the runway into Thurston Bay.)
- Installed prototype advanced taxiway guidance system.
- Developed improved pavement marking for enhancing visibility, durability, and skid resistance.
- Began operations of an aircraft deicing facility using infrared energy at a midsize airport.
- Developed driver's enhanced vision system for firefighting vehicles to navigate in rain, snow, and fog.
- Developed an environmentally acceptable replacement for the chlorofluorocarbon ozone depletor Halon 1211.

- Developed specification for 55-foot elevated boom and aircraft cabin skin-penetration system.
- Issued new pavement design standards to allow operation of Boeing B-777 without weight penalties.
- Established a Center of Excellence (COE) in Airport Pavement Research at the University of Illinois and Northwestern University.
- Installed a comprehensive instrumentation system in concrete pavements at Denver International Airport.
- Established an airport pavement data base containing field data collected at Denver International Airport, allowing on-line access to researchers worldwide.
- Published a technical report, *Intermodal Ground Access to Airports: A Planning Guide*.

#### **R&D Partnerships:**

- FAA-U.S. Army Waterways Experiment Station.\*
- FAA-U.S. Army Philadelphia District Office.\*
- FAA-U.S. Air Force, Tyndall Air Force Base.\*
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio.\*
- FAA-University of Illinois/Northwestern University (COE for Airport Pavement Research).\*\*
- FAA-Boeing Company, Cooperative Research and Development Agreement (\$7 million Boeing/\$21 million total for National Airport Pavement Test Machine).\*\*\*
- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety).\*\*\*
- FAA-NASA (for joint runway traction research).\*
- FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed).\*
- FAA-industry (to test and develop infrared-deicing facilities and soft-ground arrestor materials).

\* Interagency agreement or Memorandum of Agreement

\*\* Partnership through matching funds

\*\* Cost Sharing

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

#### **MAJOR ACTIVITIES AND ANTICIPATED FY 2000 ACCOMPLISHMENTS:**

##### *Airport planning and design technology*

- Completed data collection for taxiway center-line deviation study at John F. Kennedy International Airport, and began data collection at a second major airport.

##### *Airport pavement technology*

- Continued 3-dimensional finite element model (FEM) development: computational efficiency, advanced material models.
- Completed documentation report for layered elastic pavement design program package (LEDFAA).
- Refined failure models for 6-wheel and 4-wheel gear configurations based on analysis of data collected from FAA's National Airport Pavement Test Facility (NAPTF).
- Continued data collection and analysis at Denver International Airport (DIA).
- Published report on 3D finite element model field verification using DIA data.
- Published interim report on National Registry of Airport Pavements.

##### *National Dynamic Airport Pavement Tests*

- Completed the first series of full-scale traffic (life) tests at the NAPTF.
- Implemented a database of full-scale test results, allowing on-line access to test data.
- Began analyzing full-scale traffic test data to relate pavement performance to design.
- Reconstructed all pavement test items at the NAPTF and programmed the second series of full-scale traffic tests.
- Continued material testing and evaluation for the NAPTF.

*Airport safety technology*

- Continued development means to acquire and report runway surface friction values for pilot use.
- Complete evaluation of ramp access to commuter aircraft for people with mobility impairments.
- Completed design of next-generation airport circuitry/components test bed.
- Completed evaluation of light-emitting diode (LED) light strips.
- Completed evaluation of fiber-optic runway-distance-remaining signs at Pittsburgh International Airport.
- Initiated R&D effort aimed at providing warnings to pilots who are approaching/have approached runway holding position.
- Completed study on stability of heavy rescue vehicle and anti-rollover systems.
- Completed development of the full-scale post crash interior fire suppression facility.
- Published testing standards for airport firefighting extinguishing agents.
- Produced a manual on wildlife control methods for airports.
- Completed wildlife habitat study at John F. Kennedy International Airport focusing on grass height and vegetation types.
- Initiated the following studies on wildlife habitats: habitat study in the Pacific Northwest (focusing on vegetation); relocation of raptors at Chicago O'Hare Airport; grass height at USDA Plum Brook Station; habitat study in the southwest.
- Investigated airport wildlife control and detection techniques including use of bird effigies, laser, and microwave as wildlife dispersion methods, and evaluation of Microburst radar for wildlife detection.
- Continued to develop bird strike risk assessment factors for civilian airports.
- Set up comprehensive web site on wildlife mitigation methods and techniques, and continued to populate the National Strike Database.
- Continue to analyze full-scale traffic test data from NAPTF to relate performance to designs.
- Release updated pavement design program package (LEDFAA 2.0).
- Continue development of three-dimensional finite element based pavement design procedures.
- Continue data collection and analysis at Denver International Airport.
- Complete improvement of back-calculation methods for nondestructive testing of airport pavements.
- Produce report on taxiway centerline deviations of B-747 wide body aircraft.
- Conduct evaluation of improved airport lighting.
- Publish specifications for aircraft infrared de-icing system.
- Develop standards for anti-rollover and stability requirements for heavy airport rescue vehicles.
- Develop full scale interior fire suppression facility to perform next generation aircraft requirements research.
- Publish testing standards for airport fire fighting extinguishing agents.
- Continue wildlife habitat studies in the Southwest and Pacific Northwest, at Chicago O'Hare Airport, and at USDA Plum Brook Station.
- Continue evaluation of wildlife dispersion techniques.
- Perform wildlife habitat modeling at selected airports.
- Begin development of the National Advisory Wildlife Strike System for Airports.
- Continue populating the National Strike Database.

**KEY FY 2001 PRODUCTS AND MILESTONES:**

- Conduct the second series of full-scale traffic tests (life tests) at the NAPTF.

**FY 2001 PROGRAM REQUEST:**

The Airport Technology FY 2001 research program is a collaborative effort among many government organizations, universities, and industry associations. The program funding requested provides the contract support necessary for an integrated, effective research program that delivers

the standards and guidelines for maintaining and enhancing airport infrastructure.

# 2000 FAA NATIONAL AVIATION RESEARCH PLAN

Airport Technology Product and Activities	FY 2001 Request (\$000)	Program Schedule					
		FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY2005
<i>Airport Technology</i>	\$7,300						
Conduct the Second Series of Full-Scale Traffic Tests (Life Tests)	◆		◇				
Continue to Analyze Full-Scale Traffic Test Data from NAPTF to Relate Performance to Designs	◆		◇				
Release Updated Pavement Design Program Package							
Continue Development of Three-Dimensional Finite Element Based Pavement Design Procedures	◆		◇	◇	◇	◇	◇
Continue Data Collection and Analysis at Denver International Airport	◆		◇	◇	◇	◇	◇
Complete Improvement of Back-Calculation Methods for Non-Destructive Testing of Airport Pavements							
Produce Report on Taxiway Centerline Deviations of B-747 Wide Body Aircraft	◆		◇	◇	◇		
Conduct Evaluation of Improved Airport Lighting	◆			◇	◇	◇	◇
Publish Specifications for Aircraft Infrared Deicing System	◆			◇	◇	◇	
Develop Standards for Anti-Rollover and Stability Requirements for Heavy Airport Rescue Vehicles	◆		◇		◇	◇	◇
Develop Full-Scale Interior Fire Suppression Facility to Perform Next Generation Aircraft Requirements Research	◆			◇			◇
Publish Testing Standards for Airport for Fire Fighting Extinguishing Agents	◆		◇		◇		◇
Continue Populating the National Strike Data Base	◆			◇			
Perform Wildlife Habitat Modeling at Selected Airports	◆		◇		◇		◇
<b>Total Budget Authority</b>	<b>\$7,300</b>	<b>**</b>	<b>\$7,300</b>	<b>\$10,000</b>	<b>\$10,500</b>	<b>\$11,000</b>	<b>\$11,500</b>

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

Budget Authority (\$ in Thousands)	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Contracts	2,709	2,604	2,703		7,300
Personnel Costs	2,068	1,989	2,016	**	
Other Costs	423	407	281		
<b>Total</b>	<b>5,200</b>	<b>5,000</b>	<b>5,000</b>		<b>7,300</b>

\*\* By Congressional direction, budget line item 1F01 was reduced in FY 2000. The allocation of that reduction is currently under review.

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